



FAA-E-2687  
March 22, 1978

# DEPARTMENT OF TRANSPORTATION

## FEDERAL AVIATION ADMINISTRATION

### SPECIFICATION

#### ASDE-2 MAGNETRON SPECIFICATION

#### 1. SCOPE.

1.1 Scope. - This specification defines the requirements for the magnetron to be used in the Airport Surface Detection Equipment, Model (ASDE-2) radar, FAA type number FA-6600

#### 2. APPLICABLE DOCUMENTS. -

2.1 FAA documents. - The following FAA specifications, standards and instruction manuals of the issue in effect at the date of the invitation to bid or the request for proposals form a part of this specification and are applicable to the extent specified herein.

FAA-G-2100/1    Electronic Equipment, General Requirements;  
Part I, Basic Requirements for all Equipments

FAA-STD-013    Quality Control Program Requirements

Airport Surface Detection Equipment Model ASDE-2 type FA-6600 Instruction Manual, Volume I through III.

FAA Handbook SM P 6330 Maintenance of Airport Surface Detection Equipment (ASDE) Facilities.

2.2 Military Documents. - The following military documents of the issue in effect on the date of the invitation for bids, or request for proposals, form a part of this specification and are applicable to the extent specified herein.

MIL-E-1	General Specification for Electron Tubes
MIL-E-75	Electron Tubes, Preparation for Delivery of,
MIL-STD-1311	Test Methods for Electron Tubes

2.3 Other Publications. - The following drawing is a part of this specification and is applicable to the extent specified herein.

Electronic Industries Association (EIA)  
EIA drawing number 7449

2.4 Precedence. - When conflicts exist between the requirements of this specification and the contract, the contract shall take precedence. When conflicts exist between the requirement of this specification and its referenced documents, this specification shall take precedence.

Copies of FAA specifications and standards may be obtained from the contracting officer in the Federal Aviation Administration office issuing the invitation for bids or request for proposal. The request should fully identify the material desired, specification or standard name and number and date. The request should site the invitation for bids, request for proposal, contract involved, or other use to be made of the requested material.

Single copies of applicable military standards and specifications may be obtained by ordering through the Naval Publications and Forms Center (NPFC), which is the Department of Defense single stock print (DOD-SSP) and distribution center for unclassified specifications and standards. Documents may be ordered by writing: Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania, 19120 or by calling: Area Code 215, 697-3321, Monday through Friday from 8 a.m. to 4:30 p.m. (Philadelphia time.)

Application for copies of the Electronic Industries Association drawing should be addressed to the Electronic Industries Association, Engineering Office, 2001 Eye Street, N.W., Washington, D.C. 20006.

A copy of the ASDE-2 instruction manuals and the FAA ASDE maintenance handbook, SM P 6300 will be available in the FAA Library, Room 930, 800 Independence Ave, Washington, D.C.

### 3. REQUIREMENTS.

3.1 General. - This specification sets forth the requirements for the magnetron to be used in the Airport Surface Detection Equipment Model 2 (ASDE-2) radar, FAA model number FA-6600. This is a conventional single frequency pulse-modulated radar used for surveillance of an airport surface during periods of fog and reduced visibility. The magnetron shall be designed and produced to meet the operating requirements when installed in any of the ASDE-2 operational facilities.

### 3.2 Radar characteristics. -

3.2.1 Modulator system. - The magnetron will be driven by a FA-6618 modulator as described in the ASDE-2 instruction book. The magnetron shall meet all requirements of this specification over the range of modulator characteristics in Table 1.

TABLE 1

Pulse repetition rate	14,400 + 300 per second
Pulse duration (3dB points)	15 +8 nano seconds
Pulse risetime (10% to 90%)	4.2 + 2.5 nano seconds
Voltage rate of rise	4.0 + 2.5 kV/nano second
Modulator high voltage	adjustable 0 to 16.5 kV
Modulator current	less than 24 mA
Magnetron current	less than 5 mA

3.2.2 RF impedance. - The magnetron shall operate into any complex impedance up to a VSWR value of 1.5 to 1. The load is considered to include any waveguide, waveguide adaptor, or component attached to the magnetron in an ASDE-2 installation.

3.3 Mechanical interface. - The physical shape of the magnetron shall be such that it can be installed in the ASDE-2 radar without modification to any part of the radar. EIA drawing number 7449 describes one method of meeting this requirement.

3.4 Magnetron requirements. - When installed in a ASDE-2 system, which is operating in accordance with the ASDE-2 instruction manuals, FAA handbook SM P 6330 and within the values contained in this specification, the ASDE-2 magnetron shall produce the following operational characteristics:

3.4.1 Frequency. - The magnetron center frequency shall be within the frequency band of 23.62 GHz to 24.25 GHz. The center frequency shall be within this band for the full range of RF pulling, reference paragraph 3.5 (c).

3.4.2 Transmit power. - During design qualification and production test the magnetron shall produce not less than 8.0 Watts with the modulator high-voltage adjusted to produce a magnetron average current equal to or less than 4.0 mA. The magnetron shall produce a average power equal to or greater than 17.5 Watts without the ASDE-2 system exceeding the following maximum limits:

(a) Modulator	high-voltage	16.5 kV
(b) Modulator	current	24.0 mA
(c) Magnetron	current	5.0 mA

All power measurements shall be made at the output of the ASDE-2 directional coupler in accordance with paragraph 163 of SM P 6330.

3.4.3 Reliability. - The magnetron shall have a mean time between failures (MTBF) equal to or greater than 2,000 hours.

3.4.3.1 Life test end points. - The magnetron under life test in accordance with paragraph 4.5 will have failed when any of the following conditions cannot be met:

- (a) Average power output - equal to or greater than 14.5W with a modulator high voltage less than or equal to 16.5k V and a magnetron current less than or equal to 5.0 mA.
- (b) RF bandwidth - Reference MIL-STD-1311 paragraph 4308A, less than 40 mHz.
- (c) Stability - Reference MIL-STD-1311 paragraph 4315A, ML or MP less than 1.0%.

3.4.3.2 Operation life end point. - During its operational use a magnetron will have failed if at any time a minimum average power of 14.5W can not be achieved within the maximum limits for modulator high voltage, modulator current, and magnetron current stated in paragraph 3.4.2.

3.5 Magnetron general requirements. - The magnetron shall meet the requirements of Table 2.

TABLE 2

	<u>Condition</u>	<u>Limit</u>
(a) Heater current	Heater voltage, $E_f = 5.0V$	Heater current, $I_f = 2.6A$ to $3.2A$
(b) Holding period	$t_f = 168$ hours	
(c) Pulling Factor	VSWR equal to or greater than 1.5	Frequency change, $\Delta f$ , less than 30 mHz
(d) Stability	VSWR equal to or greater than 1.5	ML or MP less than 1.0%
(e) Heater-cathode warmup time	$E_f = 5.00 \pm 10\%$	cathode warmup time, $t_k = 180$ seconds maximum
(f) R.F. Bandwidth	VSWR equal to or greater than 1.5	less than 40 mHz at the 6dB point
(g) Center frequency	All values of pulling factor paragraph 3.5 (c)	Between 23.62 and 24.25 GHz

3.6 Modifications to the ASDE-2. - The magnetron to be delivered in accordance with this specification shall meet the full requirement of this specification without modifications to the ASDE-2 system.

#### 4. QUALITY ASSURANCE PROVISIONS.

4.1 General. - The contractor shall establish and maintain a quality control program in accordance with FAA-STD-013. Quality assurance provisions specified in section 1-4 of FAA-G-2100/1 shall apply. The contractor shall submit test procedures and test data sheets for review and approval by the Government. All testing shall be done in accordance with a Government approved test plan. These test shall include the following:

<u>Test</u>	<u>Referenced Paragraph</u>
(a) Design Qualification Test	4.2
(b) Type test	4.3
(c) Production test	4.4
(d) Life test	4.5

4.1.1 Procedures. - Submission and approval of test procedures shall be as specified in FAA-STD-013.

4.2 Design Qualification Test. - The design qualification test specified in the subparagraphs hereunder shall be performed on the first 5 magnetrons to be delivered under this contract.

4.2.1 Mechanical Inspection and Interface. - The magnetron dimensions shall be inspected to verify that the magnetron will interface with the ASDE-2. This inspection shall include, but will not be limited to, physical fit to the modulator, waveguide connection and modulator connection.

4.2.2 ASDE-2 Operational Test. - Each magnetron shall be installed in an ASDE-2 modulator. With the modulator operating within the range of values specified in Table 1 and the magnetron transmitting into a load with a VSWR equal to or greater than 1.5, each magnetron shall pass the following test:

- (a) Average power equal to or greater than 17.5 watts with a modulator high-voltage equal to or less than 16.5kV.
- (b) Average power equal to or greater than 8.0 watts with a magnetron current equal to or less than 4.0 mA.
- (c) Frequency between 23.62 and 24.25 GHz

4.2.3 Test Facility Test. - The following test may be made on the contractor's test modulator provided that they are made with a modulator pulse equal to or less than 20 nano seconds.

- (a) Heater current, reference MIL-STD-1311 paragraph 301 with  $E_f = 5.00$ ,  $I_f$  equal to or greater than 2.6A and less than or equal to 3.2A.
- (b) Heater-cathode warm uptime, reference MIL-STD-1311 paragraph 303 adjust  $E_f$  for the correct value as a function of magnetron current,  $t_k$  less than 180 seconds.
- (c) RF Bandwidth. Reference MIL-STD-1311 paragraph 4308A bandwidth shall be less than 40 mHz.
- (d) Pulling Factor. Reference MIL-STD-1311 paragraph 4310A the change in frequency,  $\Delta F$ , shall be less than 30 mHz.
- (e) Stability. - Reference MDL-STD-1311 paragraph 4315A ML or MP shall be equal to or less than 1.0%.

4.3 Type test. - The test specified in paragraph 4.2.3 shall be conducted as type test. The selection of magnetrons and the number of type test required shall be in accordance with FAA-G-2100/1 paragraph 1-4.3.3.1.

4.4 Production Test. - The test specified in paragraph 4.2.1 and 4.2.2 shall be conducted on each magnetron produced under this contract. Only magnetrons which successfully complete the production test will be accepted by the Government.

4.5 Life Test. - The contractor shall conduct a life test program in accordance with MIL-E-1 paragraph 4.6 to demonstrate that the magnetrons meet the 2,000 hour life requirement. The Group S life sampling plan, MIL-E-1, paragraph 4.6.1.9 shall be used. The end of life point shall be as defined in paragraph 3.4.3.1 of this specification. The magnetrons to be used in the initial life test must first successfully complete design qualification test in accordance with paragraph 4.2 of this specification. All magnetrons to be used in subsequent life test must first successfully complete production test in accordance with paragraph 4.4 of this specification and be a member of a type-test group which has successfully completed type test in accordance with paragraph 4.3 of this specification.

Of the three magnetrons to be utilized in the initial life test, MIL-E-1, paragraph 4.6.1.9.1, one magnetron shall be tested on the ASDE-2 modulator. The other two magnetrons may be installed on the contractor's test modulator provided that the test modulator is operated within the range of values in Table 1. Successful completion of the life test will require that the average life of the sample exceed 2,000 hours, that the life of each magnetron under test exceed 1,000 hours and that the life of the magnetron tested in the ASDE-2 modulator exceeds 2,000 hours.

5. PREPARATION FOR DELIVERY.

5.1 General. - The contractor shall pack the magnetrons in individual containers which meet the requirements of package group 9, container drop test (SC) per MIL-E-75.

6. NOTES.

6.1 Note on information items. - The contents of this section 6 are only for the information of the initiator of the procurement request and are not a part of the requirements of this specification. They are not contract requirements nor are they binding on either the Government or the contractor. In order for these items to become a part of the resulting contract, they must be specifically incorporated in the schedule of the contract. Any reliance placed by the contractor on the information in these subparagraphs is wholly at the contractor's own risk.

6.2 Government-Furnished Property (GFP). - In order for a contractor to produce a magnetron in accordance with this specification, it is necessary for the Government to furnish an ASDE-2 transmitter assembly to the contractor. Any contract based on this specification should include the following provisions:

- (a) Furnish as GFP to the contractor an ASDE-2 transmitter assembly. This assembly includes the A-scope rack, FA-6620, the transmitter (receiver rack), FA-6610 and the waveguide associated with one channel of the ASDE-2 including the directional coupler.
- (b) A requirement for the contractor to assemble the transmitter assembly in accordance with the ASDE-2 instruction manual.
- (c) An agreement under which supply support for the ASDE transmitter assembly will be provided by the FAA Depot on a reimbursable basis.

6.3 Operational life warranty. - Any contract based on this specification shall contain a 2,000 hours operational life warranty. Under the terms of this warranty it shall be the responsibility of the magnetron manufacturer to refurbish or replace at no cost to the government any magnetron which fails to meet or exceed the operational conditions, paragraph 3.4.3.2 of this specification for more than 2,000 hours of operation. If at any time more than 20% of the magnetron placed in service fail to achieve the required 2,000 hours of operational life it shall be the responsibility of the contractor to modify the magnetron design such that the magnetrons will provide the required 2,000 hour life. The contractor shall incorporate the change in all magnetrons to be delivered and shall retrofit or replace all magnetrons previously delivered to the Government.